

### REMARKS

Applicants respectfully request reconsideration of this application in view of the following remarks.

A. Status of the Claims

Claims 1, 3, 5-6, 8-10, 12-15, 17-18 and 20-26 are pending<sup>1</sup> and were found to be novel over the prior art. However, these claims were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,059,943 to Murphy et al. in view of U.S. Patent No. 5,147,722 to Koslow ("Koslow"). [11/27/06 Office Action at pp. 2-3].

B. Claims 1, 3, 5-6, 8-10, 12-15, 17-18 and 20-26  
Are Patentably Distinct From Murphy and Koslow

The rejection of claims 1, 3, 5-6, 8-10, 12-15, 17-18 and 20-26 is respectfully traversed for the reasons discussed below. In particular, Murphy and Koslow (taken singly or in combination) fail to teach, disclose or suggest a porous structure being at least partially filled with an ion-exchange resin as recited in Applicants' claim 1, and proper reasoning for making the combination is lacking in the office action.

Specifically, Applicants' claim 1 recites:

"1. An integral, substantially air impermeable polymeric membrane for use in an electrochemical apparatus or process comprising:

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<sup>1</sup> The rejection erroneously identified the rejected claims as "claims 1-15, 17-18, and 20-26." However, Applicants' November 7, 2006 amendment had cancelled claims 2, 4, 7 and 11. Accordingly, the rejected claims are understood to be claims 1, 3, 5-6, 8-10, 12-15, 17-18 and 20-26.

- a) a polymeric sheet comprising polymer and having a porous structure with a microstructure of fibrils,
- b) the polymeric sheet having distributed in the polymer:
  - i) inorganic particulate;
  - ii) metal;
  - iii) an organic polymer; or
  - iv) a combination thereof, and
- c) said porous structure being at least partially filled with an ion-exchange resin to provide ionic conductance for use in the electrochemical apparatus or process.”

1. Murphy Fails to Disclose a Polymeric Membrane with the Element c) (i.e., “An Ion-Exchange Resin” At Least Partially Filling Pores Of The Polymer) As In Applicants’ Claim 1

Murphy is directed to a composite membrane suitable for use in electrochemical devices. Murphy’s “invention provides a composite membrane consisting of an inorganic component, active for the conduction of protons or other cations, bound together by a polymeric binder phrase, which may, or may not, be an ionic conductor.” [Murphy, Col. 10, lines 40-43] As shown in Murphy’s Figure 12 (reproduced below), a conducting membrane has a polymer matrix and a proton conducting inorganic filler:

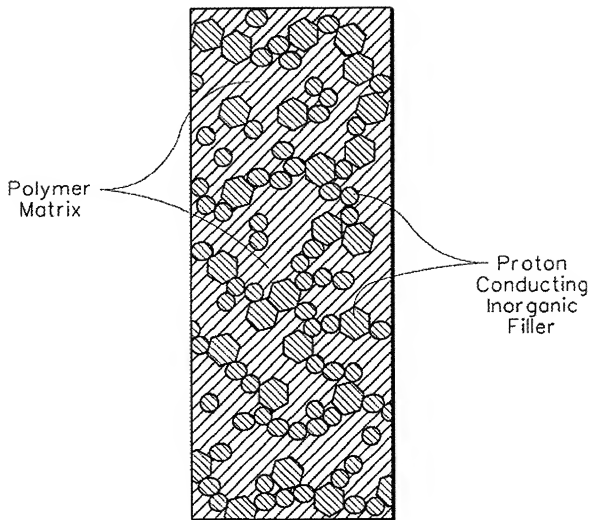


FIG. 12

Thus, Murphy's composite membrane is made from two materials, i.e., a polymeric matrix binder and a conducting filler phase. The thickness of the Murphy composite membranes is not disclosed.

Murphy's manufacturing techniques are limited to two types of embodiments. [See *generally* Murphy, Col. 9, lines 12-33; see also Col. 11, line 63 – Col. 12, line 51]. In a first type of embodiment, the pores or voids of a porous polymer matrix are filled with proton conductor particles:

- “Impregnating... into the pores of a porous polymer matrix....” [Murphy, Col. 11, lines 66-67];
- “Impregnating... into the pores of a porous polymer matrix....” [Murphy, Col. 12, lines 1-2];
- “[F]illing the pores in the filter with the desired oxide proton conductor....” [Murphy, Col. 12, lines 35-36]
- “Filling the pores of a porous polymer membrane....” [Murphy, Col. 12, line 42].

In these embodiments, the proton conductor particles occupy the pores of the polymer matrix, and are *not* distributed in the polymer matrix itself. Murphy also does *not* disclose that other materials are distributed in the polymer matrix itself. Moreover, to the extent that the proton conductor particles fully occupy the pores of the polymer matrix, an additional ion-exchange resin cannot be placed into those same pores.

The citation by the office action (at page 2) to the passage in Murphy at column 9, lines 9-12 and lines 34-36 is consistent with this understanding of the so-called filled pore embodiments. Those sentences explain that in Murphy's filled pore embodiments, the polymer matrix is both porous and flexible, and that the proton conductor particles are incorporated into pores of the polymer matrix:

“The cation-conducting composite membranes of the present invention may be made by several processes of impregnating an inorganic oxide proton conductor into the pores of a

porous polymer matrix.... The pressed membrane should exhibit good mechanical properties, such as flexibility, and be essentially gas impermeable.”

Example 1, the lone example showing preparation of a composite membrane, involves a PTFE film having its pores impregnated with a suspension of gelatinous zirconium phosphate. [Murphy, Col. 13, lines 30-50].

Applicants note that the office action further asserted that Murphy discloses at claim 1 that the porous polymer matrix is at least partially filled with “ion-exchange *particles*.” [11/27/06 Office Action at p. 2 (emphasis added)]. That claim recites:

“1. A cation-conducting, essentially gas impermeable composite membrane, comprising a polymeric matrix filled with inorganic oxide cation exchange particles forming a connected network extending from one face of the membrane to another face of the membrane.” [Murphy, Col. 14, lines 12-16].

The reference in claim 1 to “inorganic oxide cation exchange particles” is understood to be a reference to the proton conducting inorganic filler, rather than an additional ion-exchange resin or polymeric gel. Murphy mentions “Nafion®” in the “Background of the Invention” section, and asserts that the use of such polymeric materials suffers “difficulty” because “the polymer membrane requires the presence of water for conductivity.” [Murphy, Col. 1, lines 28-63]. Murphy advocates the use of “oxide proton conductors” as an alternative to these polymeric materials. [Murphy, Col. 2, lines 65-66]. Murphy touts the usage of such metal oxides because, allegedly, they have “over an order of magnitude greater than the conductivity of Nafion® measured

under the same conditions” and “have the thermal stability to remain proton conducting above 200 C.” [Murphy, Col. 4, lines 15-23]. Thus, in the “Summary of the Invention” section, Murphy describes the inorganic oxide cation exchange particles as “hydrated metal oxide[s].” [Murphy, Col. 8, lines 52-58]. This discussion makes it perfectly clear that Murphy’s inorganic oxide cation exchange particles are not ion-exchange resins and are not polymeric gels.

This understanding is entirely consistent with Murphy’s Figure 12 (reproduced above), which shows only two components in his composite membrane. Moreover, this understanding is entirely consistent with the “Detailed Description of the Invention” as “*consisting of* an inorganic component ... bound together by a polymeric binder phrase.” [Murphy, Col. 10, lines 40-43 (emphasis added)].

Accordingly, Murphy’s so-called filled pore embodiments fail to teach, disclose or suggest both “(c) said porous structure being at least partially filled with an ion-exchange resin to provide ionic conductance for use in the electrochemical apparatus or process” as recited in Applicants’ claim 1.

In a second or alternative embodiment, Murphy discloses methods for precipitating or otherwise separating for a solution a mixture of the oxide proton conductor particles and polymer binder from solution. [Murphy, Col. 12, lines 18-33]. Although these methods could incorporate proton conductor particles within the polymer matrix, Murphy does not characterize these embodiments as having pores in the polymer

matrix, or even as having a microstructure of fibrils.<sup>2</sup> Accordingly, the so-called solution embodiments fail to teach, disclose or suggest “c) said porous structure being at least partially filled with an ion-exchange resin to provide ionic conductance for use in the electrochemical apparatus or process” as recited in Applicants’ claim 1.

2. Koslow Fails to Disclose a Polymeric Membrane with Element c) (i.e., “An Ion-Exchange Resin” At Least Partially Filling Pores of the Polymer) as in Applicants’ Claim 1

Koslow is directed to production of composite material from at least one “binder” particle, consisting of microfine particulate material and “primary” particles or fibers. [Koslow, Col. 11, lines 21-25]. Koslow also discloses that “additives” and “processing aids” may be added to the mixture of the binder and primary particles. [Koslow, Col. 11, lines 30-38]. The use of PTFE is discussed by Koslow in the background section as being “complex,” “time consuming,” involving “highly toxic fumes,” and not suitable for manufacturing “thick structures.” [Koslow, Col. 3, line 42 – Col. 4, line 14]. None of the Koslow examples involve PTFE binder particles, much less expanded, porous PTFE films.

Koslow’s primary particles or fibers can consist of nearly any granular, powdered, or microfine material or a range of fine or coarse fibers. [Koslow, Col. 11, lines 25-27]. Among the primary particles disclosed by Koslow are “ion-exchange

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<sup>2</sup> Applicants note that the only disclosure in Murphy of an expanded PTFE, e.g., GORE-TEX<sup>®</sup>, is in connection with the pore filled embodiment. [Murphy, Col. 12, line 7 (impregnation of ePTFE pores filled with oxide proton conductor)].

resins.” [Koslow, Col. 9, line 4 and Col. 43, lines 65-66]. Koslow fails, however, to disclose that these ion-exchange resins are polymeric gels.

Koslow’s Examples 17-22 disclose embodiments where ion-exchange resin is incorporated into a composite structure. In these examples, mixtures are prepared from (1) minor amounts of binder resin (17 weight percent or less), (2) one or more stainless steel powders, ion-exchange resin, and chopped cellulose or acrylic fibers. [Koslow, Col. 29, line 20 – Col. 31, line 39].<sup>3</sup> An ethylene-vinyl acetate copolymer (EVA) binder resin is used in Example 17. These mixtures are subjected to a continuous web matrix (CWM) process described by Koslow, which is said to render the binder in a “continuous form or forced point-bonded condition” such that the final composite is composed of “primary particles, a binder resin phase forming a continuous web matrix or point bonds, and a volume of empty pores.” [Koslow, Abstract]. Said differently, the formerly discontinuous starting materials are processed “to form a continuous web matrix or forced point-bonds.” [Koslow, Col. 1, lines 23-27; see also Col. 4, lines 38-40]. Koslow teaches that “[t]he primary particles or fibers are entrapped and immobilized within this continuous binder resin matrix and are sometimes bonded to the structure formed from the binder resin.” [Koslow, Col. 5, lines 24-27]. At best, the ion-exchange resin beads (i.e., the primary particles) may be incorporated into his polymeric mixtures, but these ion-exchange resin beads are *not* within the pores of the final composite.

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<sup>3</sup> The office action also cited to column 25, lines 15-35. [11/27/06 Office Action at p. 3]. That passage of Koslow describes “Potential Uses” of the “invention” in the “production of sorbent structures ... of powdered and granular ... ion-exchange resins.”



Accordingly, Koslow fails to teach, disclose or suggest “c) said porous structure being at least partially filled with an ion-exchange resin to provide ionic conductance for use in the electrochemical apparatus or process” as recited in Applicants’ claim 1.

Independent claims 5, 10, 18 and 20, and dependent claims 3, 6, 8-10, 12-15, 17 and 21-26 are patentably distinct from Murphy in combination with Koslow for at least similar reasons.

3. Appropriate Reasoning for the Combination of  
Murphy And Koslow Is Lacking

In formulating a rejection under 35 U.S.C. § 103(a) based upon a combination of cited references, it is necessary for the PTO to identify the reason why a person of ordinary skill in the art would have combined the various elements in the manner claimed. A step in that process is to identify with specificity differences between the cited references and the claims in issue, and to explain why it is believed to be appropriate to combine the cited references to alleviate the admitted deficiencies.

Here, the office action has failed to expressly describe Murphy’s deficiencies, i.e., to identify what claim elements are absent from Murphy’s disclosure. Further, the office action has failed to explain what aspect of the disclosure of Koslow is being combined with Murphy, and further has failed to provide a concrete reason why a person of ordinary skill in the art would do so (in the absence of hindsight and the benefit of Applicants’ disclosure).

In this regard, the “motivation” section of the office action was directed to a reference that is *not* cited in the present office action:

“Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to insert the teachings of Koslow into the teachings of *Rusch et al.*, because Koslow teaches that the addition of fumed silica can alter the stiffness of the membrane and improve the strength of the structure.” [11/27/06 Office Action at p. 3 (emphasis added)].

Further, the alleged motivation, i.e., increasing stiffness, is contrary to the disclosure of Murphy which advocates the opposite, i.e., that the polymer matrix be flexible:

“Regardless of which polymer is used as the matrix, it is important that the polymer *remain flexible* under fuel cell operating conditions....” [Murphy, Col. 11, lines 53-57 (emphasis added); see also Col. 10, lines 45-49].

Thus, the alleged motivation to add fumed silica to increase stiffness of the membrane contradicts the disclosure of Murphy.

For at least these reasons, the Section 103 rejection of claims 1, 3, 5-6, 8-10, 12-15, 17-18 and 20-26 over Murphy in combination with Koslow is improper as proper reasoning (as opposed to improper hindsight) for making the proposed combination is lacking.

Applicants have chosen in the interest of expediting prosecution of this patent application to distinguish the cited documents from the pending claims as set forth above. These statements should not be regarded in any way as admissions that the cited

documents are, in fact, prior art. Likewise, Applicants have chosen not to swear behind Murphy, cited by the office action, or to otherwise submit evidence to traverse the rejection at this time. Applicants, however, reserve the right, as provided by 37 C.F.R. §§ 1.131 and 1.132, to do so in the future as appropriate. Finally, Applicants have not specifically addressed the rejections of the dependent claims. Applicants respectfully submit that the independent claims, from which they depend, are in condition for allowance as set forth above. Accordingly, the dependent claims also are in condition for allowance. Applicants, however, reserve the right to address such rejections of the dependent claims in the future as appropriate.


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Paper dated May 25, 2007  
Reply to Office Action dated November 27, 2006

**CONCLUSION**

For the above-stated reasons, this application is respectfully asserted to be in condition for allowance. An early and favorable examination on the merits is requested. In the event that a telephone conference would facilitate the examination of this application in any way, the examiner is invited to contact the undersigned at the number provided.

THE COMMISSIONER IS HEREBY AUTHORIZED TO CHARGE ANY ADDITIONAL FEES WHICH MAY BE REQUIRED FOR THE TIMELY CONSIDERATION OF THIS AMENDMENT UNDER 37 C.F.R. §§ 1.16 AND 1.17, OR CREDIT ANY OVERPAYMENT TO DEPOSIT ACCOUNT NO. 13-4500, ORDER NO. 0769-4624US5.

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